History of Rocketry and Astronautics

Proceedings of the Ninth, Tenth and Eleventh History Symposia of The International Academy of Astronautics

Lisbon, Portugal, 1975

Anaheim, California, U.S.A., 1976

Prague, Czechoslovakia, 1977

Frederick I. Ordway, III, Volume Editor

R. Cargill Hall, Series Editor

AAS History Series, Volume 9

A Supplement to Advances in the Astronautical Sciences

IAA History Symposia, Volume 4

Copyright 1989

by

AMERICAN ASTRONAUTICAL SOCIETY

AAS Publications Office
P.O. Box 28130
San Diego, California 92128

Affiliated with the American Association for the Advancement of Science
Member of the International Astronautical Federation

First Printing 1989

ISSN 0730-3564

ISBN 0-87703-309-9 (Hard Cover)
ISBN 0-87703-310-2 (Soft Cover)

Published for the American Astronautical Society
by Univelt, Inc., P.O. Box 28130, San Diego, California 92128

Printed and Bound in the U.S.A.

Chapter 1

ANALYSIS OF ROCKET CONSTRUCTION, DESCRIBED IN MANUSCRIPTS AND PRINTED BOOKS DURING THE 16TH AND 17TH CENTURIES*

Mieczyslaw Subotowicz†

The earliest authors before the 15th Century who dealt with rockets and rocket techniques are: Marcus Graecus [1], Ibn Albaithan [2], Albertus Magnus [3], Roger Bacon [4], Hassan Alrammah [5], and Muratori [6]. Also mentioned in the literature is the Silesian monk, Severinus [7], who used gun powder to accelerate "pipes", which probably refer to rockets. More detailed descriptions of the military rockets and fireworks appear in European writings of the 15th Century.

The first use of rockets in Europe was probably in 1241 in Legnica (Silesia), during the battle between the Polish prince Henryk Pobozny and the Tartars (Figure 1). At the beginning of the 15th Century Konrad Kyeser von Eichstädt [8] wrote a widely-known manuscript that described rocket and powder production. He wrote about the three types of rockets and produced sketches of typical powder rockets (seen in Figure 2) as well as double-direction rockets.

The Italian engineer, Joannes de Fonana [10], presented prototype projects of an aerial torpedo able to produce a blast and of a reaction airplane -- a kind of rocket with the wings. Also known is a sketch of a double-direction rocket of Regionmontanus [12].

Very important achievements in non-standard rocket construction are contained in a manuscript by Konrad Haas [16] found in the library of the city Sibiu in Rumania [53]. The manuscript consists of three parts, probably written by three different authors living in the years 1380-1569. In the third part, techniques for production and some applications of one- and multi-step rockets are described. The unknown author of the first part may be Hans Haasenwein. The author of the third part, Konrad Haas, was born in Dornbach near Vienna and served as chief of the artillery arsenal of the town Sibiu/Herrmannstadt. A relationship appears to exist between Konrad Kyeser's *Bellifortis* with the manuscripts of the later technicians, including Haas. His manuscript contains some sketches of the two-stage rocket,

* Presented at The Ninth IAA History of Astronautics Symposium, Lisbon, Portugal, September 1975.

† Institute of Physics, M. Curie-Sklodowska University, Lublin, Poland.

seen in Figure 3, a three-stage rocket, a double-direction rocket, a rocket battery, a combined two-step rocket, and delta-shaped stabilizers used in rocket flight. Haas also dealt with primitive ballistics and flight theory.

Figure 1 Fresco in the abbey built on the battle place by Legnica, Silesia, of the Polish army against the Tartars in 1241. The fresco shows the drake fire head that could be propelled by rocket action.

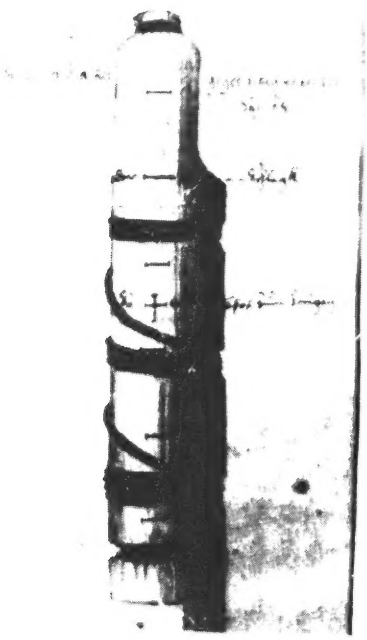


Figure 2 Sketch of rocket from the book of Konrad Kyeser von Eichstädt [8], 1405.

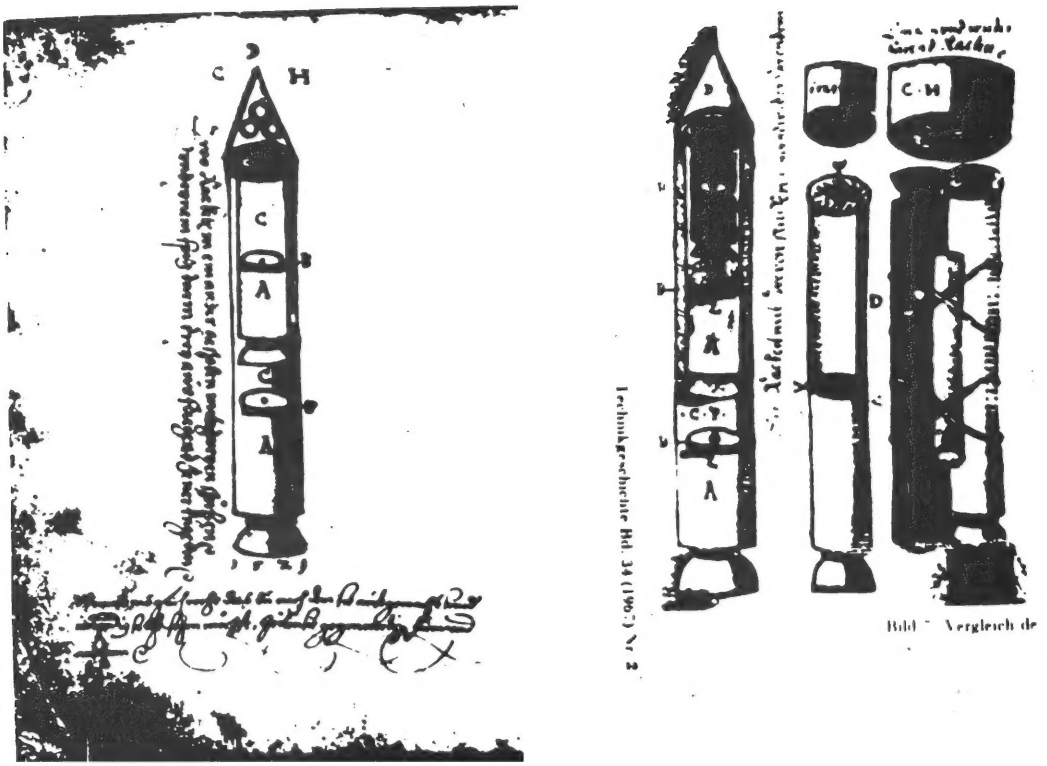


Figure 3 Sketch of two-step rocket from book by K. Haas [16], 1529-1569 (left); and sketch of Haas three-step rocket and double-direction rocket (right) [16]

An author who dealt with non-standard rocket design, Vanuccio Biringuccio [17], described a combined two-stage rocket whose second stage was the rocket battery. Reinhard von Solms [19] wrote on rockets with parachutes. In Leonhard Frönsperger's book [21] are sketches of a two-step rocket and of a double-direction rocket (shown in Figure 4). Frönsperger had probably seen [53] the Haas manuscript [16].

Especially well-known was the book of Johann Schmidlap [24], published in 1561 and republished in 1590, 1591 and 1608. It contains sketches (Figure 5) of two-stage and double-direction rockets. It is highly probable that some parts of the Haas' manuscript were copied by Schmidlap in his book [24, 53].

Details of rocket technology were first published in Poland by Marcin Bielski [25], Figure 6, and by S. Sarnicki [26].

Many technicians and artillery specialists [27-51] dealt with rockets in books or manuscripts. Only non-standard rocket construction is noted in the following paragraphs.

It appears that in the early years of the 17th Century the manuscript of Walenty Sebisch [31], was written. He was the military architect of the town Wroław. The

manuscript contains sketches of rockets with the delta-type stabilizers, Figure 7a; rocket batteries, Figure 7b; and something like a two-stage rocket, Figure 7c.

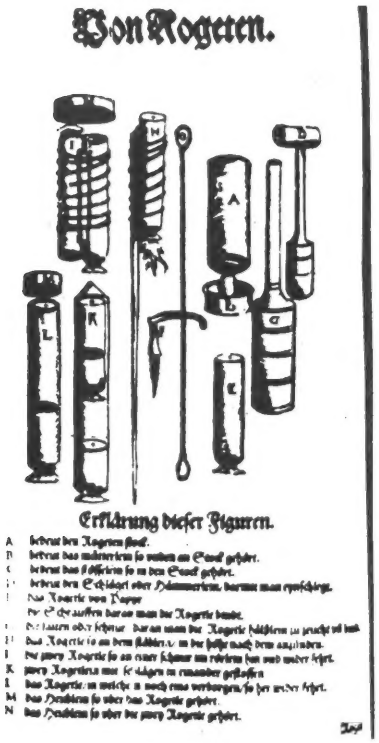


Figure 4 Sketch of two-stage rocket and of double direction rocket from L. Frönsperger [210], 1557.

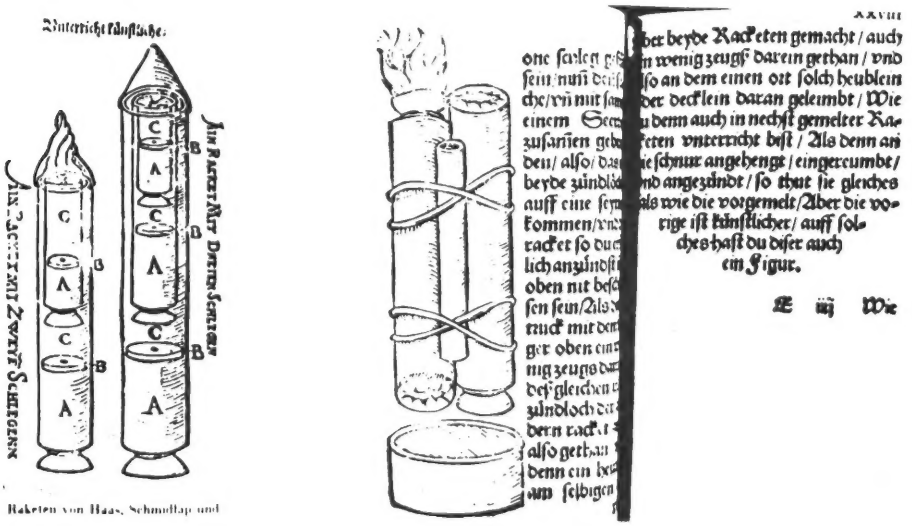
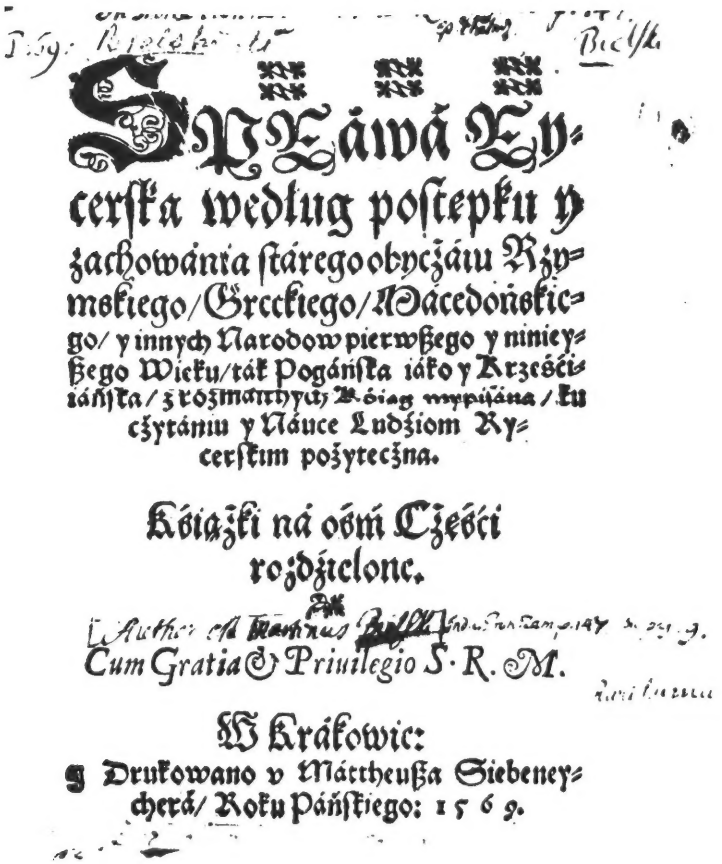


Figure 5 Sketch of the two-stage and three-stage rockets of J. Schmidlap [24], 1561 (left); and sketch of his double-direction rocket (right) [24].


SPRáwá Ry-
cerſka wedlug poſtępku y
zachowánia ſtárego obyczáiu Rzy-
mskiego/Greckiego/Macedońskie-
go/ y innych Narodow pierwßego y niniey-
ßego Wieku/ták Pogáńſka iáko y Krześći-
áńſka/ z rozmaitych Ksiąg wypiſána/ ku
czytániu y Náuce Ludźiom Ry-
cerſkim pożyteczna.

Kśiążki ná ośm Części
rozdźielone.

Cum Gratia & Priuilegio S. R. M.

W Krákowie:
Drukowano v Mátthewßa Siebeney-
cherá/ Roku Páńſkiego: 1569.

Figure 6 Title page of work by M. Bielski, 1569, written in Polish [25] in which details of rocket production are described.

Another manuscript is that of A. dell Aqua [41], an artillery specialist of Italian origin who served in the armies of Polish kings and princes. His book was written between in 1630 and 1635 and contains a sketch of a two-stage combined rocket (Figure 8). The second stage of the rocket is a rocket battery, which consists of five small rockets.

Kazimierz Siemienowicz [43] occupies a special place among authors of non-standard rocket concepts and designs. Serving as artillery general of the Polish king Władysław IV during the first half of the 17th Century, he wrote an excellent book [43] that was translated into English and other European languages (Figure 9a). Siemienowicz incorporated excellent sketches in his book of various rocket configurations, as noted in Figures 9b and 9c. They included multi-stage rockets, rocket batteries, conical nozzles, delta-type stablizers, double-direction rockets and combined rockets, wherein one or more multi-stage rockets form the rocket battery. Similar rocket concepts appeared in books and manuscripts prepared by many authors during the second half of the 17th Century, and later.

When analyzing non-standard rocket designs by the above-mentioned authors, it is usually not possible to find connections between them. But there are two exceptions, namely, Frönsperger's work [21], and that of Schmidlap [24]. Both are believed to be connected [53] with the Haas' manuscript [16]. When we examine the military and entertainment applications of these rockets, some construction solutions appear quite obvious. Fireworks were in common use for a long period in courts of kings and princes. Therefore, it is highly probable that all the designs and concepts already described were proposed quite independently by different authors, even up to the 20th Century [52].

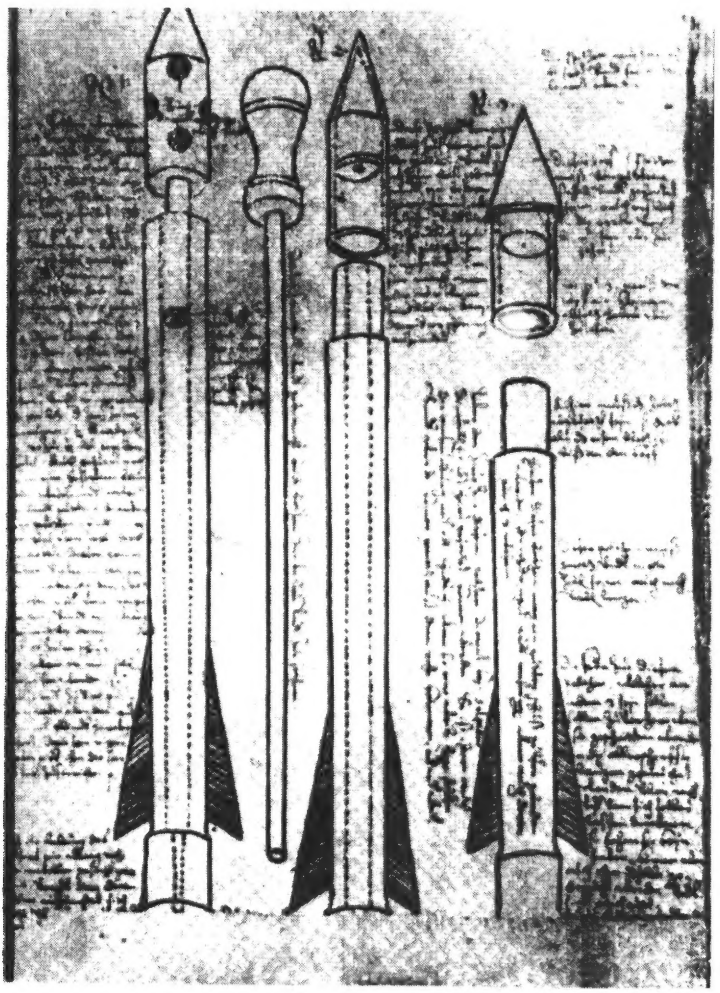


Figure 7a Delta-type rocket stabilizers by Sebisch [31] about 1600.

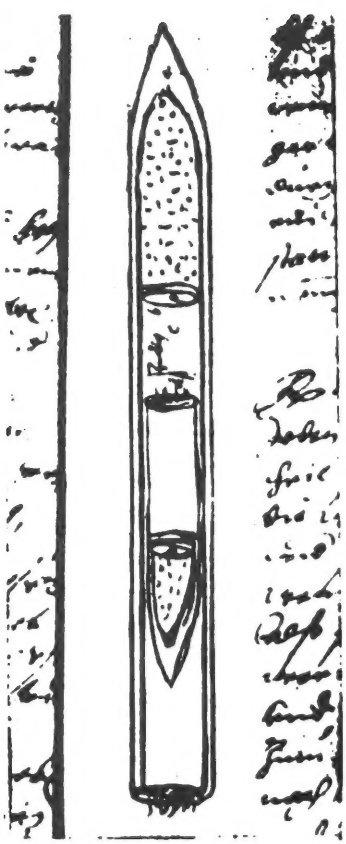


Figure 7b & 7c Sketch by Sebisch of rocket battery, about 1600 (left); and of his two-stage rocket (right) [31].

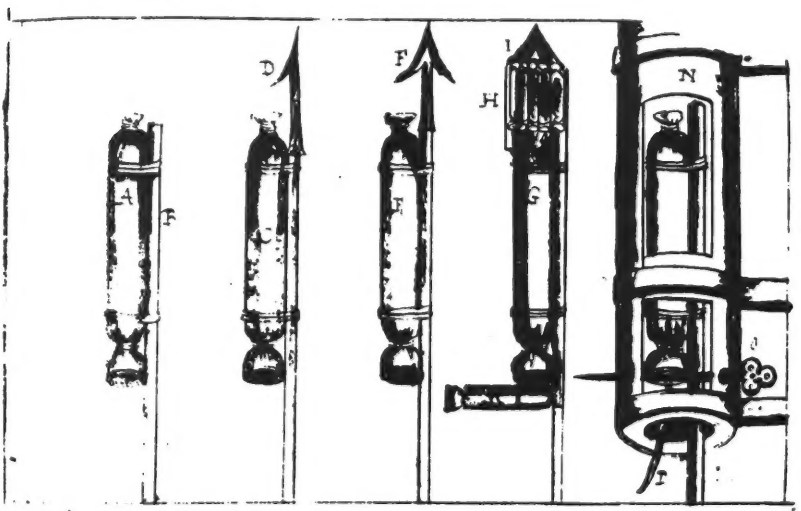
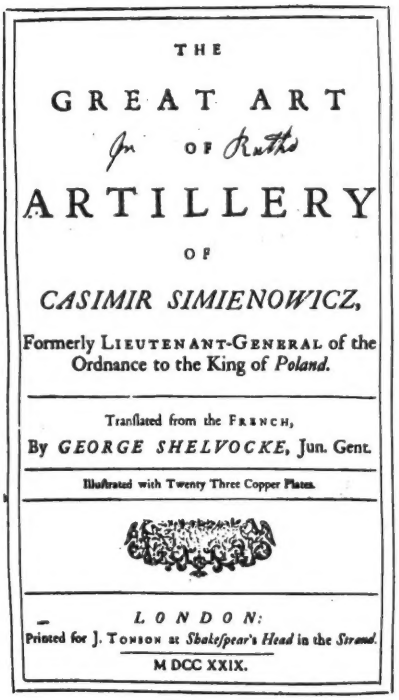


Figure 8 Sketch of two-stage combined rocket by A.dell Aqua [41], 1630-1635.



THE

GREAT ART

OF

ARTILLERY

OF

CASIMIR SIMIENOWICZ,

Formerly LIEUTENANT-GENERAL of the Ordnance to the King of *Poland.*

Tranſlated from the FRENCH,

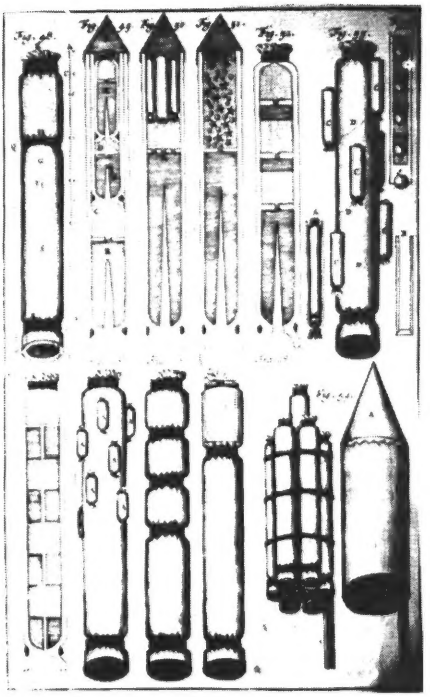
By *GEORGE SHELVOCKE,* Jun. Gent.

Illuſtrated with Twenty Three Copper Plates.

LONDON:

Printed for J. TONSON at *Shakeſpear's Head* in the *Strand.*

M DCC XXIX.



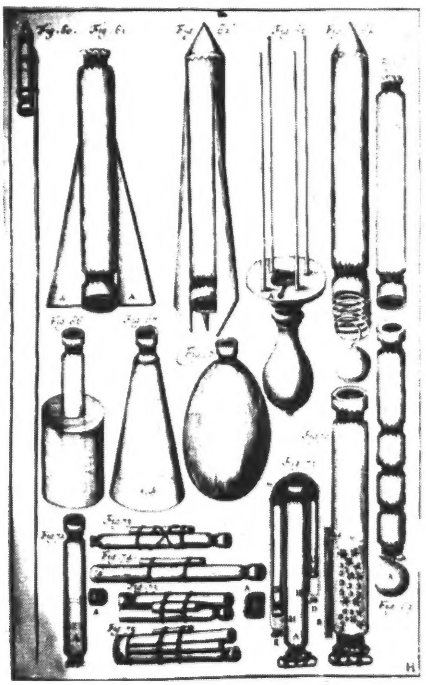


Figure 9 Title page of the English translation, 1729, of the Siemienowicz book [43], 1650 (top left); sketches of his [43] three-stage rocket, two-stage combined rocket and of the rocket battery (top right); of his double-direction rockets and of the delta-type rocket stabilizers, 1650 (bottom).

REFERENCES/BIBLIOGRAPHY

1. Marcos Graecus, *Liber ignium* (Fire-Book), 1230-1250, ed. Paris, 1804
2. Ibn Albaithar (Abú Mohámmad Abdallach ben Ahmad Almaliqi), 1240
3. Albertus Magnus, *De mirabilibus mundi*, between 1250-1280
4. Roger Bacon, *De secretis*, Opus Major, 1268
5. Hassan Alrammah, 1280, "The Book of Fighting on Horseback and with War Engines", manuscript
6. Muratori, 1379. Italian historian, describing the role of rockets in the battle of the Isle of Chiozza
7. Severinus, 1380, Polish monk writing on rockets. He was mentioned in the paper of T. Przypkowski: "Nowe z'ródla historyczne do najdawniejszych zastosowan' rakiet na terenie Polski", Technika Rakietowa, No. 7, 1959, p. 41-47 (in Polish)
8. Konrad Kyeser von Eichstädt, *Bellifortis*, 1405
9. Feuerwerksbuch, before 1430
10. Joannes de Fontana, *Bellicorum Instrumentorum Liber*, 1420
11. Hans Hartlieb, 1437, German writer on powder production
12. Regiomontanus, 1450
13. Franz Helm, *Buch von den probierten Künsten*, 1528-1535
14. Hans Bustetter, 1524-1532
15. Ott von Ochterdingen, 1526-1529
16. Konrad Haas, Sibiu Manuscript, 1529-1569
17. Vanuccio Biringuccio, *De la Pirotechnia*, 1540
18. Gaspar Brunner, 1542]
19. Prince Reinhard von Solms, 1547, manuscript
20. Albert de Prusia, 1551
21. Leonhard Frönsperger, *Von Geschütz und Feuerwerk*, 1557, Frankfurt am Main
22. Hans Camentur, 1560
23. Hans Starck, 1560
24. Johann Schmidlap, Künstliche und rechtschaffene Feuerwerk, Nürnberg, 1561, 1590, 1591, 1608
25. Marcin Bielski, Sprawa Rycerska, Kraków, 1569
26. S. Sarnicki, 1575-77, rekopis: "Ksiegi hetmánskie" manuscript: "Hetman's books", Jagiellonian Library in Cracow, No. 171
27. Franz Brechtel, 1591
28. Luigi Collado, 1592
29. A. Capo Bianco, 1598
30. J. Boillot, 1598
31. Walenty Sebisch 1577-1657, Manuscript in Wroclaw about 1600

32. Onisim Michajłow, Ustaw ratnych, puszecznych i drugich diel, kasajuszczichsia do wojennej nauki, 1607-1621 (in Russian)

33. Ch. Dambach, 1609

34. Prince von Nassau, 1610, manuscript, p. 725

35. A. v. Roomen, 1611

36. Diego Uffano, 1613 Archelia albo artilleria, to lest Naka y Informatia o Strzelbie y Rzeczach do niey nalez'a,cych je,zkiem polskim s'wiez'o napisana, Leszno, 1643; it is Polish translation from the German language by J. Dekan of the Spanish book, "Tratado de la artilleria", Bruxelles, 1613

37. J. Sattler, 1619

38. F. Thybourel, 1620

39. J. Furtenbach, "Architectura navalis" and "Halinitro-Pyrobolia"; 1627, written in German

40. F. de Malthe, 1629

41. A. del Aqua, *Praxis re,czna dziela*, 1630-1635 (ed. PWN Warszawa, 1969)

42. J. Appier de Hanzelet, 1630

43. K. Siemienowciz, *Artis Magnae Artilleriae...*, Amsterdam, 1650

44. Malthus, *Pratique de la guerre contenant l'usage de l'artillerie*, Paris, 1668

45. H. Fabri, 1669

46. Daniel Schwenter, *Delicae physico-mathematicae*, Nürenberg, 1681

47. Valentin Franck von Franckenstein, *Breviculus Pyrotechnicae*, Sibiu, 1697

48. Nicolas François Blondel (1617-1686), *L'art de jeter les bombes*, Haga, 1685

49. Robert Anderson, *The making of rockets*, London, 1696

50. Suvirey de Saint Remy, *Mémoires d'artillerie*, Paris, 1697

51. Noni Ewangelista, *Trattato de Fouchi Artificianti per adenita e ricreazioni*, before 1700, Mariqueni

52. M. Subotowicz, Kwart.Hist. Nauki i Techn., 13, 807-10, 1968

53. D. Todericiu, *Raketentechnik in 16. Jahrhundert* ..., "Technikgeschichte", 34, 97-114, 1967, Düsseldorf

D. Todericiu, *Preistoria Rachetti Moderne Manuscrisul de la Sibiu* (1400-1569), Bucuresti, 1969

D. Todericiu, Kwart.Hist. Nauki i Techn., 15, 545, 1970